A wire is 3 m long and has a diameter of 2 mm. The resistance of this wire is 25 ohms. If a potential difference of 60 V is applied between the ends:

(a) What is the conductivity of the material from which the wire is made?

(b) How much power is provided by the 60 V source?

(c) What is the electric field in the wire?

(d) How much charge flows through the wire in 7 seconds?

\[ A = \frac{\pi d^2}{4} = \frac{\pi \cdot (0.002 \text{ m})^2}{4} = 3.14 \cdot 10^{-6} \text{ m}^2 \]

\[ \rho = \frac{AR}{L} \]

\[ \sigma = \frac{1}{\rho} = \frac{L}{AR} = \frac{3 \text{ m}}{3.14 \cdot 10^{-6} \text{ m}^2 \cdot 25 \Omega} = 38200 \frac{1}{\Omega \text{ m}} \]

\[ P = \frac{V^2}{R} = \frac{(60 \text{ V})^2}{25 \Omega} = 144 \text{ W} \]

\[ E = \frac{V}{L} = \frac{60 \text{ V}}{3 \text{ m}} = 20 \frac{\text{ V}}{\text{ m}} \quad (E = \rho \cdot J \text{ leads to the same answer}) \]

\[ i = \frac{V}{R} = 2.4 \text{ A} \]

\[ q = i \cdot t = 2.4 \text{ A} \cdot 7 \text{ s} = 16.8 \text{ C} \]